

OKLAHOMA
AGRICULTURAL AND MECHANICAL COLLEGE
AGRICULTURAL EXPERIMENT STATION
STILLWATER, OKLAHOMA

THE BABCOCK TEST
for
FAT IN MILK AND CREAM

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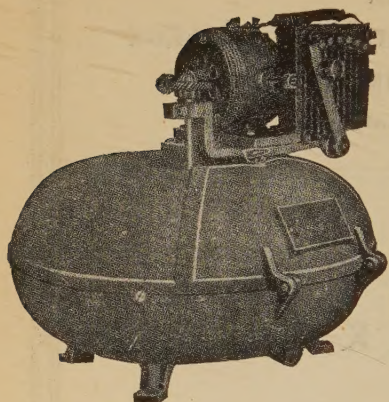
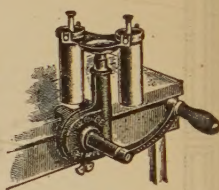


Figure 1.—Electric Tester

Figure 2.—Twelve Bottle
Hand TesterFigure 3.—Two Bottle
Hand Tester

Types of Babcock Testers

Figure 4.—Ten
Per Cent Milk
Test BottleFigure 5.—Fifty
Per Cent Short
Neck 9 Gram
Cream Test Bottle

Types of Test Bottles

THE BABCOCK TEST FOR FAT IN MILK AND CREAM

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HOW TO TEST MILK FOR FAT

General

It is important to know the fat content of milk because:

1. It enables one to determine the producing ability of individual cows or the herd as a whole.
2. It provides the most reliable and simplest method of eliminating the unprofitable cows from the herd.
3. It largely establishes the commercial value of dairy products.
4. It enables one to check the efficiency of various farm processes such as separating, churning and cheese making.
5. It furnishes a reliable index of the food value of milk.

Making the Test

Necessary Equipment

To make the test the following supplies and equipment will be needed:

1. A Babcock centrifuge.
2. Babcock milk test bottles (Oklahoma State Standard).
3. Commercial sulphuric acid (specific gravity 1.82-1.83).
4. A 17.6 cubic centimeter milk pipette.
5. A 17.5 cubic centimeter acid measure.
6. A Fahrenheit thermometer.
7. A hot water bath in which to temper the completed test.
8. Dividers for reading the test.

Performing the Test

1. Temper the milk to a temperature of 60-70 degrees Fahrenheit. Mix thoroughly by pouring rapidly from one vessel to another three or four times, being careful to avoid the formation of excessive foam or air bubbles. Never shake the sample as this incorporates air and if continued, causes churning.

If milk from a single cow is to be tested, the entire volume should be obtained and mixed before taking a sample for analysis because the last milk from the udder is richer than that first drawn.

2. Insert the pipette into the well mixed sample and draw the milk above the mark on the large stem of the pipette. Quickly place the forefinger over the opening of the large stem and by releasing pressure, allow



Figure 6.—A
17.6 cc Milk
Pipette



Figure 7.—
Acid Measure

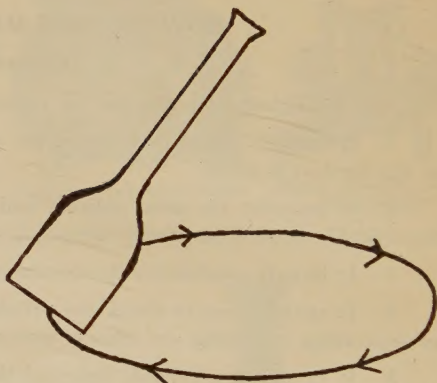


Figure 8.—To Mix Acid and Milk, Give the Bot-
tle a Rotary Motion

Glassware Used in Testing

the milk to flow out until the bottom of the slightly curved surface (the meniscus) corresponds with the mark.

3. Insert the pipette into the neck of the test bottle and allow it to drain. Blow out the last drop. Unless the small tube of the pipette can be inserted entirely through the neck of the bottle into the bulb, it will be necessary to hold the bottle in a slanting position while adding the sample. This allows the milk to flow down the side of the bottle neck and permits the escape of air from the bottle thus preventing any loss of milk.

4. Fill the acid measure to the 17.5 cc. mark with sulphuric acid and while holding the bottle at an angle and turning slowly, add the acid in such a way that all adhering milk is washed from the neck.

5. The acid and milk form two distinct layers and should now be mixed thoroughly by giving the bottle a rotary motion. (See figure 8).

6. Place bottles in the tester so that each bottle is counterbalanced by another placed directly opposite in the corresponding cup. The tester **MUST** be balanced. Whirl in the tester for five minutes at the speed indicated. For a hand centrifuge this is usually 40 to 60 turns of the handle per minute, depending upon the size of the machine.

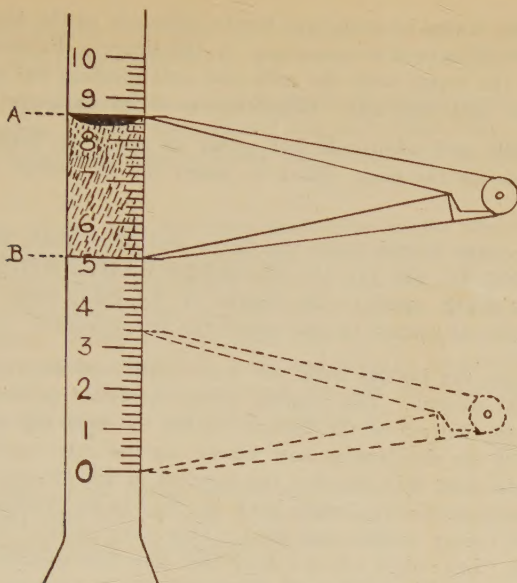


Figure 9.—Reading a Milk Test. Read from A to B

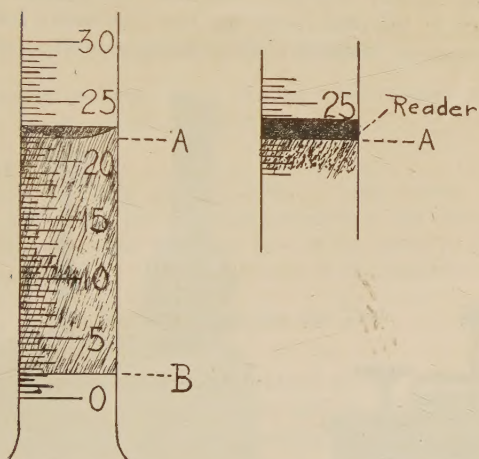


Figure 10.—Reading a Cream Test. Add Glymol and Read from A to B. Note in Figure on Right How Glymol Flattens the Meniscus

Reading Milk and Cream Tests

7. Add hot water to each test bottle, filling it to the base of the neck. The water should have a temperature of 180 degrees Fahrenheit or above. Do NOT mix the water with the milk and acid mixture but allow it to flow down the bottle neck carefully. Centrifuge or whirl again for two minutes.

8. Carefully add additional hot water as above to bring the clear fat within the scale on the neck, filling to about the 8% mark. Centrifuge for one minute.

9. Remove the bottles from the tester and place them in a bath of hot water HEATED TO 130 TO 140 DEGREES FAHRENHEIT. The water should have a depth equal to the height of the fat column in the bottles. Allow the bottles to remain in this water for five minutes.

10. Remove the bottles from the water bath and by means of dividers, measure the fat column. The reading should be taken as noted in the illustration, from the bottom of the column to the extreme top of the meniscus. If one point of the dividers is now placed on the zero mark of the bottle scale, the other point will register the percent of fat directly. It should be noted that the scale on the bottle neck has ten large divisions representing a total of 10% (some bottles read 8%). Therefore each of the ten divisions represents 1%. Since each 1% is sub-divided into five smaller divisions these represent .2% each. The 8% bottle which is used in certain localities and also some 10% bottles, have their 1% divisions sub-divided into ten equal parts in which case the smaller divisions represent .1% instead of .2%. On the bottle neck shown in the illustration the test represents 3.4% because three of the large divisions are included in the reading as well as two of the smaller

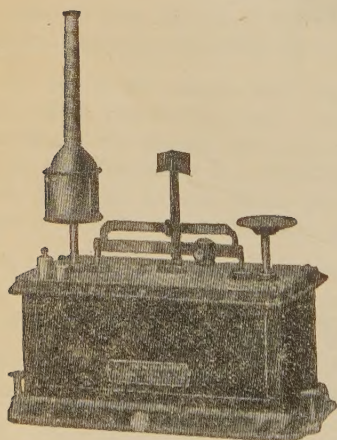


Figure 11.—Single Bottle Balance

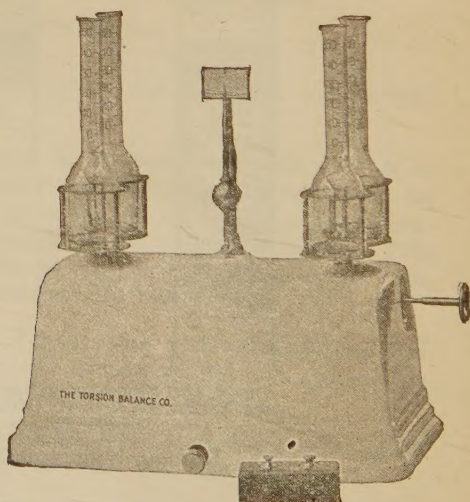


Figure 12.—Four Bottle Balance

Types of Torsion Cream Balances

divisions, the two smaller divisions representing .2% each. (See figure 9). Record the test in decimals and not in fractions. Thus: 4.5%, NOT 4½%.

11. A test should always be made in duplicate which means making two tests of each sample. These tests should not vary more than .2% one from the other. A greater variation indicates inaccuracy and the tests should be repeated.

12. As soon as the test has been made the bottles should be washed. To facilitate draining they may be inverted in a board containing a series of small holes through which the bottle neck is inserted. Shaking the bottles while draining will assist in removing the white deposit thrown to the bottom during centrifuging. When drained, they should be washed with hot water containing some washing powder or soda and then be thoroughly rinsed. A bottle brush greatly assists in removing deposits and keeping the bottles clean. Dirty bottles produce inaccurate results.

Precautions

1. **Be Careful.** Acid burns clothes and flesh. If acid is spilled on the hands, wash it off with cold water. If spilled on clothing, moisten the spot with dilute ammonia water, (ammonium hydroxide).
2. Testers must always be balanced and oiled.
3. Milk and acid should have a temperature of from 60-70 degrees Fahrenheit.
4. Mix acid and milk as soon as acid is added.
5. Acid absorbs moisture from the air and becomes weakened. Keep the bottle tightly stoppered when not in use.

Basis of the Test

Sulphuric acid dissolves all the solids in milk except the fat. It also produces heat, keeping the fat in a liquid condition and increases the specific gravity of the mixture, thus enabling the fat to come to the surface more readily. The application of centrifugal force then completes the process.

Factors Affecting the Test

The Acid

Acid should have the same temperature as the milk, 60 to 70 degrees Fahrenheit. If too warm it chars the fat and the column appears dark. If too cold it fails to dissolve the milk constituents other than fat and the fat column may appear light or cloudy. The use of either too warm or too cold acid may result in an incorrect test.

The acid should have a specific gravity of 1.82 to 1.83. Too strong acid such as the chemically pure product, has the same effect as acid too warm and may result in a charred fat column. Conversely, acid too weak affects the test in the same manner as acid which is too cold, yielding a light colored fat column and probably an inaccurate test.

The method of adding acid is likewise important, especially in the case of testing cream. If the acid be allowed to drop directly onto the cream or milk through the neck of the bottle that portion of the sample with which it suddenly comes in contact, may become charred and dark particles may appear in the fat column. The acid should be allowed to flow down the side of the neck, collect beneath the milk and then be immediately mixed by giving the bottle a rotary motion.

Overcoming the Above Difficulties

If the acid is too warm or too strong, use slightly less than the regular amount or cool it to the desired temperature. Conversely, troubles caused by too weak or too cold acid may be eliminated by using more than the required amount or warming to the desired temperature.

The Milk

The temperature of the milk is equally as important as the temperature of the acid and should be between 60 and 70 degrees Fahrenheit because at this temperature the pipette delivers the correct quantity into the test bottle. If too warm the volume delivered will be less than the required amount and charred particles may appear in the fat column. Conversely, if too cold, the action of the acid may be hindered thus resulting in a light colored fat column. Again, because milk contracts when cold, too large a quantity is delivered by the pipette into the bottle and a high test will be the result.

The character of the milk is especially important. Churned or curdled milk are both difficult to test unless special procedures be followed and the results obtained can only be considered approximate. Frozen milk may be tested if melted at a temperature not to exceed 100 degrees Fahrenheit. As soon as melted it should be cooled to 60-70 degrees Fahrenheit, thoroughly mixed, and the test conducted in the usual manner.

The Water Used for Filling Test Bottles

Only soft water should be used for filling test bottles as hard water may produce foam on top of the fat column and result in an incorrect test. This foaming is caused by the action of sulphuric acid on the carbonates in hard water. If hard water must be used the above difficulty may be eliminated by adding a few drops of sulphuric acid to the water before use. Boiling the water is another remedy which frequently overcomes the difficulty by precipitating the carbonates.

The Centrifuge

Few farms are equipped with a steam heated centrifuge. Therefore, it becomes necessary to provide some method of keeping the bottles warm during the process of centrifuging. This may be accomplished by placing the bottles in water at a temperature of about 180 degrees Fahrenheit for a few minutes during the filling process between whirlings.

The speed of the centrifuge is likewise important and the operator must turn the crank at the correct number of revolutions per minute for the stipulated time. A centrifuge turned too slowly or one which is run for too short

a period may result in the failure of some fat to collect in the bottle neck, resulting in a low and inaccurate test. Little effect will be noted if the tester is run longer than the usual length of time except that a clearer fat column may result. If run too fast bottles may be broken.

The Bottle Bath

The bottles are constructed to give a correct reading when the fat within the scale on the neck has a temperature of 130 to 140 degrees Fahrenheit, hence the reason for placing the bottles in the water bath at 130 to 140 degrees Fahrenheit for five minutes. If the bottle bath be too cold the fat column contracts and the test will be too low. If too hot the column expands and the test will be too high.

Preservation of Samples

Sometimes it is necessary to keep samples for one or several days before a test can be made. For this purpose corrosive sublimate tablets, obtainable from any dairy supply house, are perhaps the most desirable but because of being a VIOLENT POISON must be used with caution and kept out of the reach of children. The tablets should contain a coloring material to color the milk and indicate its poisonous qualities. One tablet is sufficient to preserve a pint of milk for about two weeks; however, to be effective the tablet must be entirely dissolved in the sample. This is readily accomplished by crushing before adding it to the milk. Follow this by giving the bottle a gentle rotary motion to insure thorough mixing. The addition of any subsequent milk should be followed with a similar mixing.

NOTE: Preservatives must NOT be added to milk samples on which a bacteriological test is to be made.

HOW TO TEST CREAM FOR FAT

General

For accurate results cream MUST be weighed instead of measured into the test bottle because:

1. Cream may contain air bubbles thus preventing the correct amount from being delivered by a pipette.
2. Cream varies in viscosity, hence if measured a variable quantity would stick to the inside of the pipette.
3. Cream varies in specific gravity or relative weight, rich cream being lighter than thin cream. Hence a pipette would not regularly deliver the correct amount into a test bottle.

Making the Test

Necessary Equipment

1. A Babcock centrifuge.
2. Torsion cream scales with weight.
3. Cream test bottles (Oklahoma State Standard).
4. Commercial sulphuric acid.

5. A 9 cubic centimeter pipette.
6. A 17.5 cubic centimeter acid measure.
7. A Fahrenheit thermometer.
8. A hot water bath in which to temper the completed test.
9. Glymol (sometimes called red reader) or light oil to remove the meniscus.
10. Dividers for reading the test.

Performing the Test

1. Cream testing bottles considered as standard in Oklahoma, are the following:

1. The 50%, 9 gram, 6 inch bottle (short neck).
2. The 50%, 18 gram, 9 inch bottle (long neck).
3. The 30%, 18 gram, 6 inch bottle (short neck).

The bottles most generally used are the 50%, 9 gram, 6 inch type.

2. Mix the sample thoroughly by pouring from one vessel to another several times. If the cream has aged and become stiff so that mixing is difficult, it should be warmed to a temperature not exceeding 100 degrees Fahrenheit and poured from one vessel to another until thoroughly mixed.

3. With the scales resting on a level support, place a cream test bottle on opposite scale pans and balance accurately.

4. Place a 9 or an 18 gram weight, corresponding to the bottles used, on one side of the balance opposite the bottle into which the cream is to be weighed and add cream carefully until the scales again balance. Remove the weight and counterbalance the first bottle by an addition of cream to the bottle on the other balance pan. Nine or eighteen grams of cream will now have been weighed into each of the two bottles.

5. Add 10 to 15 cubic centimeters of acid in small quantities, allowing the bottles to stand for a few seconds after each addition and mixing in order to observe the color development which in cream appears more slowly than in milk. The addition of acid is continued until the mixture is a deep chocolate color. This practice avoids charring the fat which might occur if the acid were added too rapidly or in too large quantities. Because cream contains less solids-not-fat than milk the smaller quantity of acid is used. After the addition of acid and the development of the proper color, some operators add about 5 cc. of cold water to the mixture. If preferred, the 5 cc. of water may be added to the charge of cream in the test bottle just before the addition of acid, the purpose of the water in either case being to check the action of acid and prevent the charring of fat.

6. Centrifuge as for milk for 5, 2 and 1 minutes, making two fillings with hot water.

7. Remove from the centrifuge and place the bottles in a water bath heated to 130 to 140 degrees Fahrenheit. Allow the bottles to remain in this water for 5 minutes as in the case of milk. This step is important because the fat column when hot expands and when cold contracts. Numerous experiments have proven the importance of tempering the fat if accurate results are to be obtained.

8. Add 3 to 4 drops of glymol to the top of the fat column and read the test immediately, taking the measurement from the bottom of the fat column to the line of demarcation between the glymol and the fat, reading to the nearest per cent or half per cent mark. Always add glymol carefully, allowing it to run down the bottle neck and collect on top of the fat column. Dropping glymol directly on the fat column may cause it to mix with the fat and produce inaccurate results. To obtain a correct reading it is absolutely essential that glymol be used. Reading to the top of the meniscus produces results which are too high. Conversely, a reading to the bottom of the meniscus gives results which are too low. It is not possible to obtain correct results by estimating half of the meniscus. Experiments have definitely proven the necessity of adding glymol.

Precautions

1. The same precautions should be observed as under the test for fat in milk.

2. Occasionally a fat column appears cloudy. This may be due to several causes such as insufficient acid. The difficulty can sometimes be overcome by placing the bottles in water heated to near the boiling point for 10 to 15 minutes followed by subsequent whirling. However, in the case of all poor results it is desirable to repeat the test.

Basis of the Test

The principle of the test is the same as that given under testing for fat in milk.

LAW REGULATING TESTING

Following is a copy of the general law of Oklahoma relating to the testing of dairy products and equipment used in making the test:

Chapter 248

House Bill No. 403, Relating to Testing Glassware Used in Connection With Butterfat Tests.

An Act Providing for the Control, Specifications and Requirements of Testing Glassware that May Be Shipped into, Manufactured or Used Within the State in Connection With Butter Fat Test, the Reading of Tests, and the Accuracy of Cream Scales, and Fixing Penalty for Violation Thereof.

Be It Enacted By the People of the State of Oklahoma:

Marking of Glassware—Manufacturer's Bond.

Section 1. Any and all pieces of testing glassware shipped into or manufactured within the State shall have clearly blown, or otherwise permanently marked, in the side of the bottle, the word "Sealed," and in the side or bottom of the piece the name, initials or the trademark of the manufacturer and designating number, which designating number shall be different for each

manufacturer and may be used in identifying the bottles. The designating number shall be furnished by the State Dairy Commission or Commissioner upon application by the manufacturer, and upon filing by the manufacturer of a bond in the sum of One Thousand (\$1000) Dollars, with sureties to be approved by the Attorney General, conditioned upon their conformance with the requirements of those sections relating to specifications therefor. A record of the bonds furnished the designating numbers, and to whom furnished, shall be kept in the office of the State Dairy Commission or Commissioner.

Penalty

Section 2. Any manufacturer who sells testing glassware to be used in this State that fails to comply with the specifications in the Section relating thereto, shall suffer the penalty of Five Hundred (\$500.00) Dollars, to be recovered by the Attorney General in an action against the offender's bondsmen, to be brought in the name of the people of the State.

Inspection and Tests

Section 3. (a) State Inspectors of Dairy Products are required to examine all glassware in creameries, cream stations and in all other places where milk or cream is bought or sold by test, as provided in this Act, for butter fat, and determine whether such glassware is properly marked and sealed, and shall be required from time to time to collect samples of glassware to be calibrated and examined by the experiment station Chemist of Oklahoma, for the purpose of determining the capacity of the graduated portions of the necks of test bottles and whether or not the glassware meets all the provisions of the sections pertaining thereto.

(b) All users of glassware where milk or milk products are bought or sold on a butter fat test, shall be required to submit, within ninety (90) days after this Act shall go into effect, all pieces of glassware to be used by them to the experiment station Chemist of Oklahoma, to be calibrated, and such pieces as pass inspection shall be permanently marked with the letters "S. D. C." and returned at the owner's expense. Provided, that nothing in this Act shall apply in case of violations of provisions in this section.

Standard Test Bottles

Section 4. The standard test bottles for milk shall have a capacity of two cubic centimeters for each ten (10) per cent marked on the necks thereof.

The necks of the standard milk test bottles shall be graduated from zero to ten (10) per cent and the graduated scale shall be seventy-five (75) millimeters in length, with an allowable tolerance of five (5) millimeters either above or below. The graduated scale shall be plainly divided into per cent and fifty (50) per cent divisions by lines of different lengths. Each per cent graduation shall be numbered and the tolerance for the entire graduated scale or for either half thereof shall not exceed one-tenth of one per cent.

(a) Milk pipettes shall deliver 17.6 cubic centimeters of distilled water,

the last drop being expelled by pressing the finger over the suction tube and holding the bulb of the pipette in the hand.

(b) When filled with water at 20° C. delivery shall be in 4 to 8 seconds. The tolerance in excess or deficiency shall not exceed .05 cubic centimeters.

(c) Cream Test Bottles: Cream test bottles shall be of three types and shall comply with the following specifications:

Type A—Fifty (50) per cent, 9 gram, 6 inches, one-half ($\frac{1}{2}$) per cent graduation. Each ten (10%) per cent of the neck of the bottle shall represent a volume of one cubic centimeter.

The neck of the bottle shall be graduated from zero to fifty (50%) per cent and the graduated scale shall be ninety (90) millimeters in length, with an allowable tolerance of ten (10) millimeters above or below. The graduated scale shall be plainly divided into five (5%) per cent, one (1%) per cent and one-half ($\frac{1}{2}$ %) per cent divisions by lines of different lengths. Each five (5%) per cent or ten (10%) per cent graduation shall be numbered. The allowable tolerance for calibration shall not exceed one-half per cent for the entire graduated scale or for either half thereof.

Type B—Thirty (30) percent, eighteen (18) gm., six (6) inches, one-half ($\frac{1}{2}$ %) per cent graduations. Each five (5%) per cent on the neck of the bottle shall represent a volume of one cubic centimeter. The neck of the bottle shall be graduated from zero to thirty (30) per cent, and the graduated scale shall be seventy-five (75) millimeters in length. All other specifications are to be the same as Type A.

Type C—Fifty (50) per cent, 18 gram, 9 inches, one-half per cent graduations. The neck of the bottle shall be graduated from zero to fifty per cent and the graduated scale shall be one hundred and twenty-five (125) millimeters in length, with an allowable tolerance of five (5) millimeters, whether above or below, each five (5%) per cent on the neck of the bottle shall represent a volume of one cubic centimeter. All other specifications are to be the same as for Type A.

Testing Dairy Products

Section 5. It shall be unlawful for any person, by himself, his servant or agent, or as the servant or agent of another, to falsely manipulate or underread or overread or make any false determination by the test as provided in this Act, or any other contrivance used for the determining the quality or value of milk or cream delivered to a creamery, cheese factory, cream receiving station, ice cream factory, or at any other place when sold or purchased. Cream shall be tested by weight only.

All tests must be free from curd, charr or other foreign matter, and shall be read at a temperature of 130 degrees to 140 degrees F. and glymol shall be used to reduce the meniscus, before the reading is taken on cream tests.

Cream Scales

Section 6. Cream test scales shall be sensitive and accurate to one-tenth part of one gram. The test of accuracy shall be made by noting the action

of the scale when a 100 mg. weight is placed on the pan when the scale is in a balanced position.

Penalty

Section 7. Anyone violating any of the provisions of this Act shall be deemed guilty of a misdemeanor and shall, upon conviction, be fined not less than twenty-five (\$25.00) dollars, nor more than fifty (\$50.00) dollars, or imprisoned in the county jail for thirty days, or both such fine and imprisonment.

Approved April 4, 1919.

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